Human Systems Readiness: Challenges and Solutions for the Future

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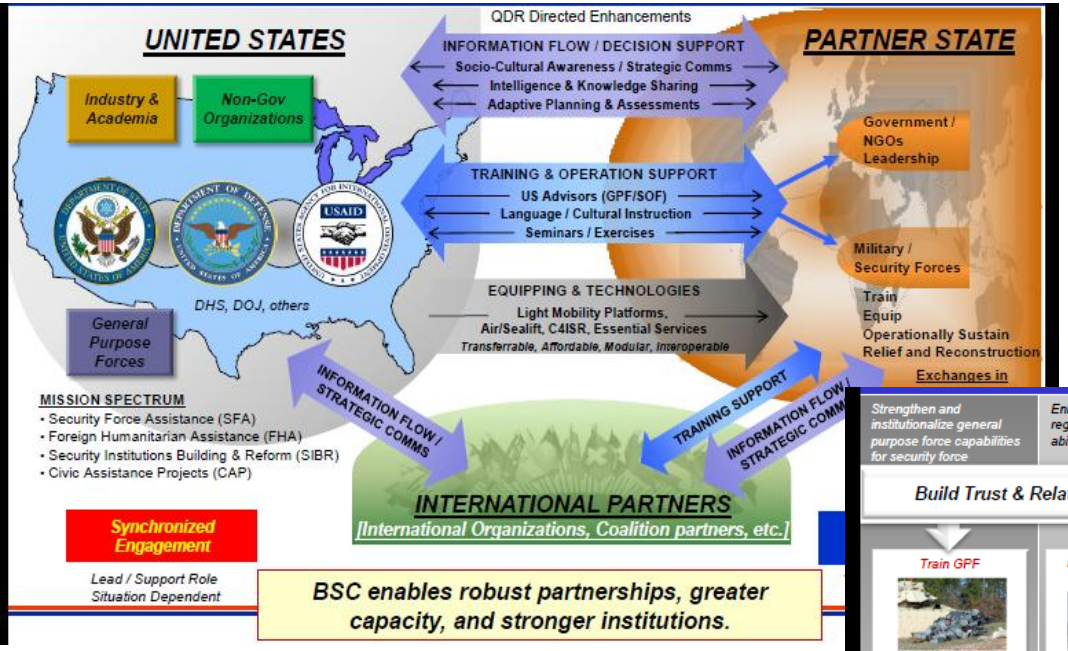
NDIA S&T Conference

What HS Readiness Means to the Warfighter

Building a Common View Towards HS Readiness



OV-1 for BSC as a Template

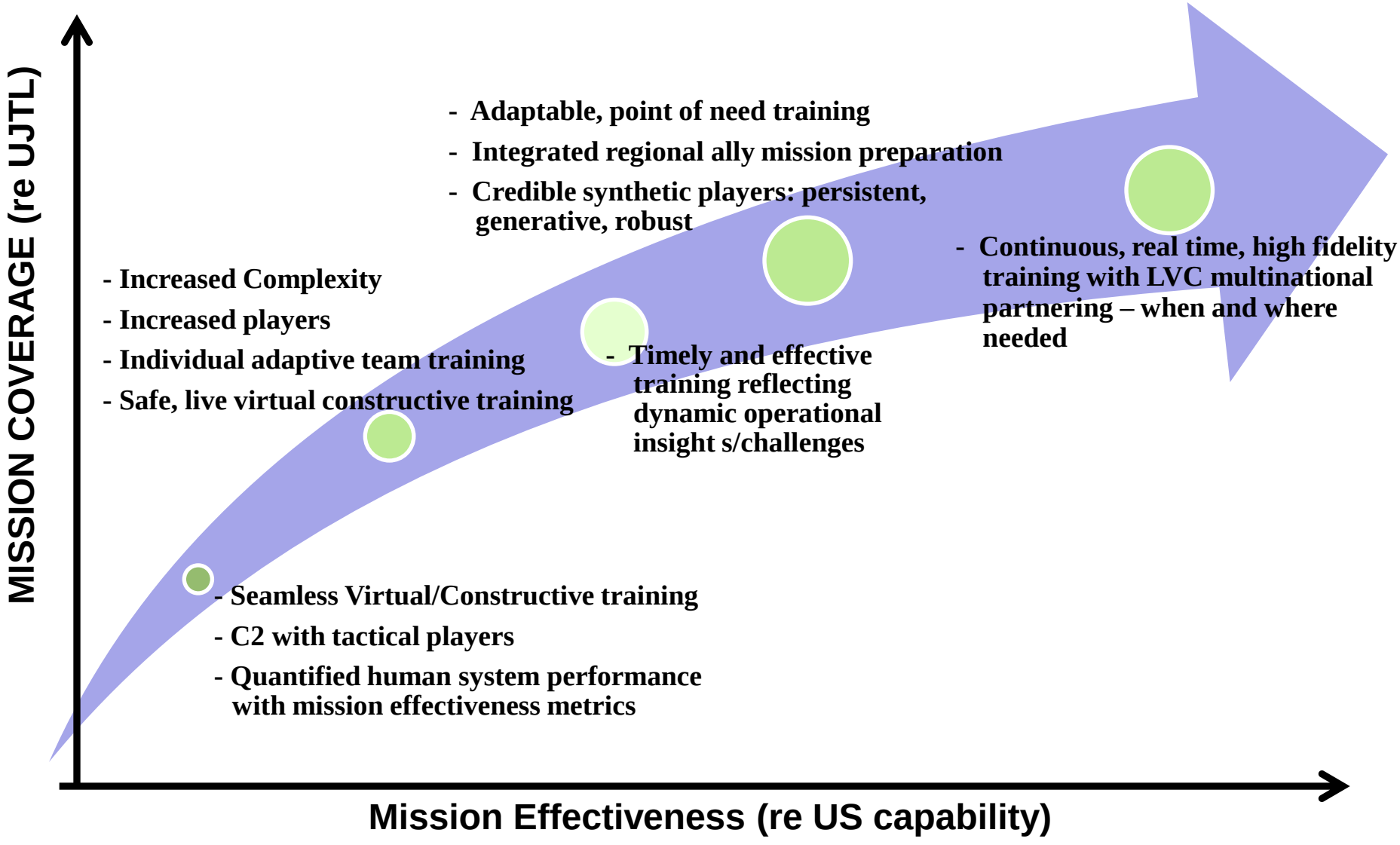
OV-5 for BSC as a Template

Human Systems
Training for Readiness

- **Problem: Complex Evolving Threats Outpace Readiness Training**
  - **Warriors train for tomorrow's fight using yesterday's technology, methods, and strategies**
  - **Current training scenarios not matched to evolving mission complexity and dynamics … threats**
  - **Warfighters are trained to doctrine -- fight strategically and dynamically to meet new threats**
  - **Training is costly**
    - **Live systems deplete inventory, consume fuel, require maintenance & wear out**
    - **Ranges & role players are expensive – lack responsiveness to changing scenarios**
    - **Training ranges not designed for flexible training and throughput is inadequate**

- **Preliminary End States**
  - **Quantified human-system performance based on mission effectiveness metrics**
  - **Enhanced capabilities of coalition partners and regional allies**
  - **Real time updates and adaptive training, paced by individual and team capabilities & experience**
  - **Mixed-reality synthetic environments to enable efficient individual/team training**
  - **Synergized training in tactical proficiency with new full C4ISR and weapons systems capabilities**
  - **Training that is ubiquitous, adaptive, scalable, flexible, individualized and seamless from basic training to flexible pre-deployment tactics**

Training
With End States



End Points -- Training

- **3 year -- Training-based metric of mission effectiveness**
  - Integrated virtual and constructive training for mission realism, scale, and accessibility
  - Mission scenarios for integrated training of combat teams and C2 operations for realism and accessibility
- **5 year – Real time effectiveness assessment for adaptive training**
  - Real time individual training assessment and adaptation for focus and effectiveness
  - Expand mission sets for flexible CONOPs exploration
  - Individual adaptive team training and assessment for flexibility and realism
  - Live + virtual + constructive training for scale and realism
- **7 year – Training extension to field for continuous training**
  - Adapt training mission scenarios to new threats and CONOPs for enhanced value
  - Port to hand-held devices for accessibility and job aiding
  - Capture lessons learned in training scenarios for mission rehearsal and readiness
- **10 year – Training extension to coalition and allies for building partner capacity**
  - Integrated regional ally mission preparation
  - Synthetic operators (persistent, generative, robust, credible, synthetic Players)

An Example of Basic Science Supporting Training
US Army Virtual Human Basic Research

Laboratory Basic Research:

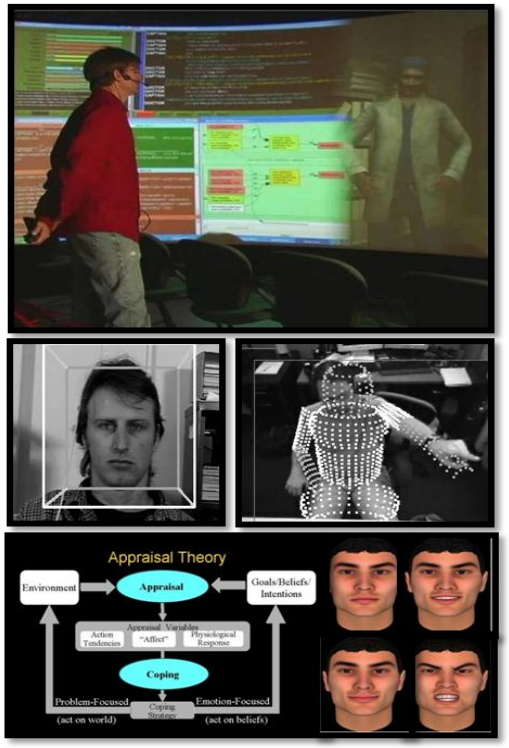
- Capturing human appearance and behavior in virtual human characters
- ARL research in conjunction with partners including the Army Research Institute the University Affiliated Research Center, the Institute for Creative Technologies (ICT)
  - Virtual Human Basic Research
  - Medical Simulation and Training

Supports Interpersonal Skills Training

Capturing human appearance and behavior in virtual human characters
- Use of appraisal and decision theory and computational approaches to model human emotion and cognition
- Use of computer vision for recognition and understanding of nonverbal gestures
- Translate findings of Social Sciences into human behavior models
- Developing a virtual human character creation pipeline

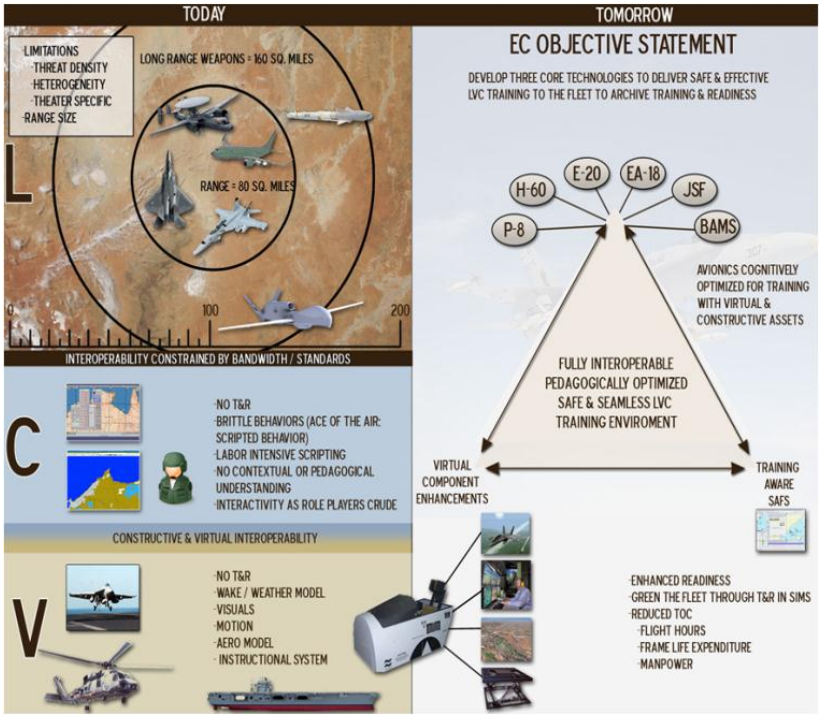
Apply the laboratory findings to the development of:

- Demonstrations that virtual human behaviors influence human decisions
- Incremental advances in recognition and generation of speech (e.g., reduced latencies in character responses)
- Advanced dialogue authoring methods
- Improved appearance and gesture authoring tools



An Example of Field-Level Training
USN/USAF Live Virtual and Constructive Training

Goal: **Reduce the time required to create combat readiness and operational proficiency while cost-effectively maximizing transfer from the classroom/trainer to the operational environment , using LVC capabilities.**



Technology Challenges:

1) Virtual-Constructive Representations on Live Avionics Displays: Technology solutions will be developed to integrate these simulations into, &represent them on, live aircraft displays in a safe manner that does not degrade an aviator's ability to 'aviate-navigate-communicate.'

2) Optimal Fidelity Synthetic Environments: Planned efforts will lead to guidelines & techniques to optimize the use of virtual simulations as part of Naval aviation centric LVC training.

3) Tactically Behaving Semi-Automated Forces: Planned efforts will develop forces that can use incoming data from the LVC training system to rapidly generate tactically believable behaviors while reducing the need for human operator input.

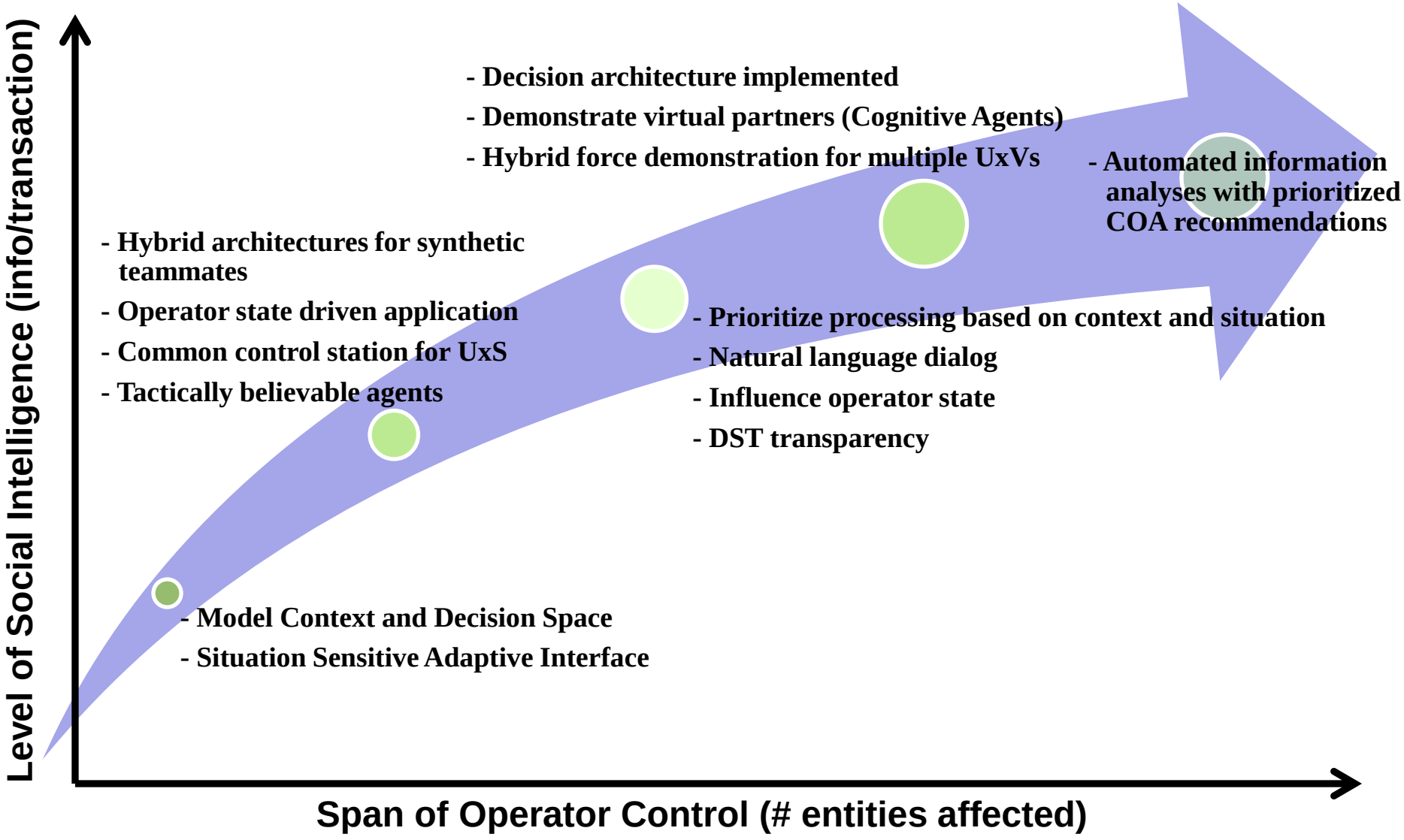
4) Learning Management System: A interactive toolset for event planning, instructional design, scenario authoring and performance measurement warehousing

Human Systems
Interface for Effectiveness

- **Problem: Current system operation is rigidly data-centric vice flexibly information-centric**
  - **Modern technologies exacerbate critical manning and talent pool deficiencies by ignoring role of Mission, Task & Context – Moving & presenting data vice information**
  - **Current adaptive planning tools do not allow rapid "course of action" analysis and generation**
  - **Information displays typically non-interactive, adapting little to changing needs**
  - **No asymptote detected in burgeoning data quantity in the far term**

- **Preliminary End State**
  - **Speed of Command through agile exchange of Information with system-level data management – Based on Mission, Task & Operational Context**
  - **Agile interfaces responsive to people, mission, resources**
  - **Systems provide Timely and Useful decision support – Flexible & tailored to operational needs**
  - **Robust Information management despite Cyber limitations**
  - **Efficient & Effective Interaction with human & virtual team-mates for decision aiding and reach-back**
  - **Real-time course of action generation**

Interfaces
With End States

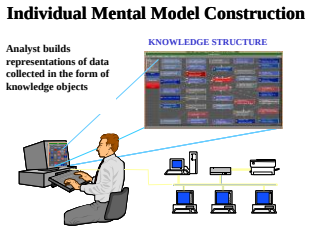


End Points – Interface

- **3 year – Tactically Believable Agents for Mission Planning**
  - Task-Centric Interfaces for Increased Speed and Accuracy of Decisions
  - Decision Aiding in Common Control Station for UxS
- **5 year – Hybrid Architectures for Synthetic Teammates**
  - Situation Sensitive Adaptive Interface for Dynamic Planning and Execution
  - Operator State Driven Adaptation for Mission Performance Management
- **7 year – Socially Responsive Interface to Hardware, Software, Human Systems**
  - Natural Language Dialog for Human Autonomy Interaction
  - Task Prioritization Algorithms Based on User Models and Context
- **10 year – Interactive Collaboration with All Capability Components**
  - Cognitive Architecture for Decision Support
  - Hybrid Force Demonstration for UxV Mission Sets
  - Context Sensitivity to Commander's Intent

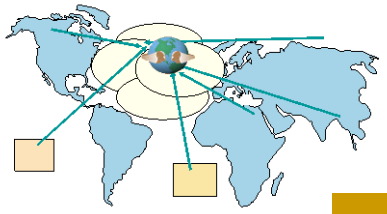
USN Example Collaboration and Knowledge Interoperability

Individual Knowledge Building



Developing Knowledge Interoperability

Work by teams whose members are separated by space and time.



Attaining Shared Understanding

Team Consensus Development

Program Vision

Identification, measurement and understanding of the high-level team knowledge building processes used by autonomous, agile, quick-response combat teams in order to improve complex problem solving, decision making and team performance.

Research Challenges and Opportunities:

Algorithms for automated discourse analysis to understand team knowledge building and decision-making processes

Development of Intelligent Proxy-agents and optimizations to provide real-time interventions and improve human and mixed-initiative teamwork

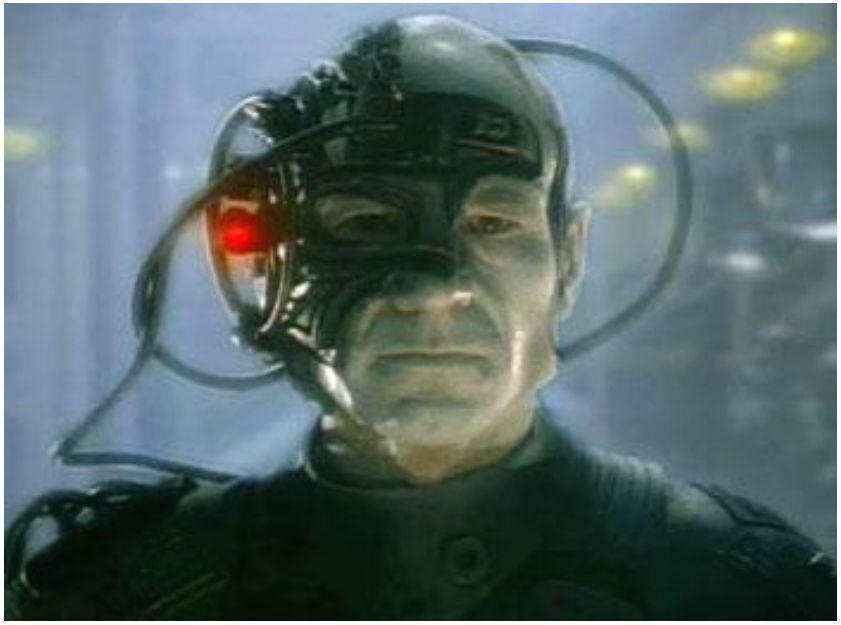
Development of mathematically rich computational team mental models and associated measurement metrics

Human Interface to Cyberspace

Cyber Mission Essential Competencies (MEC)

- **MEC analyses of AF cyberspace operations**
- **Understand the skills that must be supported by interfaces for cyber operations in the field**

Seamless integration of the human operator in the cyber domain; achieve ***appropriate awareness, understanding and control*** of the environment & participants



New NDIA Division in Formative Stages
HUMAN SYSTEMS

Mission

To promote the exchange of technical information and discussions between government, industry, and academia, and the expansion of research and development in areas related to the human as a system whose performance must be integrated into any system of systems

Objectives

- Advocate human-centered research and the integration of cognitive and biological technologies
- Promote discussions to make the "human factor" a top priority in Research, Development, Test and Evaluation (RDT&E)
- Conduct studies and prepare reports in response to requests from the DoD HS Community of Interest (CoI)
- Advocate, lead, and influence increased discussion and research on the elements of human-system integration (HSI)